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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

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Federal Communications Commission
Office of Secretary

In the Matter of)

Notice of Inquiry on)
Implications of Information)
Service and Internet Usage)

CC Docket No. 96-262
CC Docket No. 94-1
CC Docket No. 91-213
CC Docket No. 96-263

COMMENTS OF NORTEL

Stephen L. Goodman
David E. Colton
Halprin, Temple, Goodman & Sugrue
1100 New York Avenue, N.W.
Suite 650, East Tower
Washington, D.C. 20005
(202) 371-9100

Counsel for Northern Telecom Inc.

Of Counsel:

John G. Lamb, Jr.
Northern Telecom Inc.
2100 Lakeside Boulevard
Richardson, Texas 75081-1599

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SUMMARY

Northern Telecom Inc. ("Nortel") supports the Commission's efforts to encourage growth in the Internet and other advanced telecommunications services. The Internet's increasingly important place in American commercial, public and private life can be attributed in part to the Commission's policy initiatives which promoted its development.

Internet-related activity is distinct from traditional telecommunications industries because of the absence of artificial barriers to entry imposed by regulations. Markets are also permitted to function with a minimum of government interference. Innovative telecommunications services, increased choices for consumers and advanced educational and other opportunities for all Americans are the result.

Concerns over the impact of growing Internet traffic on the circuit-switched voice telephony network prompted the Commission to inquire about effective regulations to remove the potential for network congestion. Nortel believes that the Commission should adhere to its historic preference to refrain from regulation of Internet-type packet networks and rely on technological, competitive and market-driven solutions as both more appropriate and more effective. Nortel's Internet Thruway

is an example of an industry response to this market need that is being successfully deployed by carriers.

The Commission should also review its regulations to permit carriers to potentially earn a rate of return on their Internet-related investments commensurate with the risks involved. The Internet is a developing industry and the potential for risk and reward are correspondingly high. Properly aligning risk with compensation would permit carriers to participate in the industry on an equal and non-discriminatory basis.

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Northern Telecom Inc. ("Nortel") hereby comments on the notice of inquiry addressing implications of information service and Internet usage for the public switched telephone network.^{1/} Nortel supports the Commission's efforts to understand the policy implications of this dynamic new industry so as to maintain its remarkable record of growth, innovation and benefit to the American public. As detailed below, Nortel believes that the Commission should follow its historic commitment to policies that will "preserve the vibrant and competitive free market that

^{1/} Notice of Proposed Rulemaking, Third Report and Order, and Notice of Inquiry, FCC 96-488, released December 24, 1996 at ¶ 311 (hereafter cited as "Notice").

currently exists for the Internet and other interactive computer services."^{2/}

I. INTRODUCTION

Nortel is the leading global supplier, in more than 100 countries, of digital telecommunications systems to businesses, universities, local, state and federal governments, the telecommunications industry, and other institutions. The company employs more than 23,000 people in the United States in manufacturing plants, research and development centers, and in marketing, sales and service offices across the country.

Nortel has been an active participant in the numerous fora addressing the development of new packet-switched telecommunications services. Nortel has operated an ever-growing and ever-faster global intranet first installed in the late 1980s, has a class "A" address,^{3/} was a board member of ANS (the Internet backbone operator formed by MERIT (consortium of nine Michigan universities, IBM, MCI and Nortel) and contributes through various fora on issues such as technical co-operation and

^{2/} Telecommunications Act of 1996, Pub. L. No. 104-104, 110 Stat. 56, *to be codified at* 47 U.S.C. §§ 151 *et. seq.* at § 230(b)(2) (1996) [hereinafter "the 1996 Act"].

^{3/} There are 127 possible Class A networks in the world; only 60 have been assigned. Each Class A network can support up to 16 million addresses or hosts. There are 48,000 Class B networks, supporting up to 65,000 addresses or hosts. The 16 million Class C networks can support only 256 addresses or hosts.

interoperability of networks and systems. Nortel was one of the early and strong supporters of industry efforts to foster the development of the Internet and associated advanced telecommunications services. Nortel is thus highly interested in this proceeding.

II. THE COMMISSION CAN BEST PROMOTE DEVELOPMENT OF THE
INTERNET AND DIGITAL DATA NETWORKS BY RELIANCE ON
MARKET FORCES AND COMPETITION

The Internet emerged in 1995 from the confines of limited academic use and federal government subsidy to become what is now a mainstream feature of American life. Nortel believes that how the Internet became such an integral factor in American commercial, social and political activities in less than two years is instructive.

In large part, two interrelated factors drove this process: (i) competition made possible by low barriers to entry with many new market entrants; and (ii) reliance on market forces for investment, pricing and efficient resource allocation. Both factors stimulated rapid development of the Internet's physical infrastructure (routers, servers and transport lines) and software (Web browsers, e-mail, video and other content development).

Absence of traditional barriers to entry such as proprietary control of the Internet's underlying technology^{4/} places a premium on quickly developing and introducing technical innovation to market.^{5/} Moreover, the absence of traditional telecommunications regulations dictating which industry players may obtain access to the market (such as Section 214, etc.) and on what conditions, encourages innovation and competition. Freed from the distortive impact of regulation affecting other portions of the telecommunications industry, the young market for Internet-related products and services appears to be growing more rapidly than the early emerging markets for print publishing, telephony, radio, television and recorded music.^{6/}

The Commission is to be commended for its technology-neutral, de-regulatory policies regarding the Internet's

^{4/} For example, the Internet relies on open standards. Together with UNIX, developed by Bell Labs and released into the public domain, the Transmission Control Protocol and Internet Protocol ("TCP/IP") was developed to permit ARPANet computers to talk with one another regardless of operating system. Today, TCP/IP is used worldwide by all computers connecting to the Internet.

^{5/} Netscape, for example, releases a new version of its market-leading Netscape Navigator Web browser with new features and extensions approximately every six months. Microsoft releases versions of its browser at the same or faster pace. The same dynamic affects digital hardware as well. According to industry observer Don Tapscott, the average commercial lifespan of a digital consumer electronic device is now two months. D. Tapscott, The Digital Economy 63 (1996).

^{6/} The Internet Report, Morgan Stanley (1996) (noting that initial household penetration and usage rates outpace adoption patterns of previous technologies).

development. Nortel believes that the public interest would be ill-served by imposing unnecessary regulations on this vibrant sector. The Internet industry's current vigor and the Congressional directive in the 1996 Act to promote reliance on market forces indicate that the Commission should continue its de-regulatory approach to the Internet and extend it to future digital technologies. Nortel believes that development of the Internet and high-bandwidth data networks can be facilitated by the Commission's removal of regulatory encumbrances on carriers, including incumbent LECs, IXC's and CAPs, which may hinder or slow their participation in this flourishing market.

The FCC should be technology neutral with respect to services regulations.⁷¹ Such a policy will promote competition and market entry and will preserve incentives for investment and innovation in the underlying traditional circuit-switched network as well as accelerate the deployment of new networks and technologies. Packet-switched networks that are ubiquitously "connection oriented" (like X.25 protocols such as Tymnet, or ATM and/or frame relay) and that can provide guaranteed minimum delay and guaranteed available bandwidth (essential for voice communications and many enterprise data applications) are competing with an ubiquitously "connectionless oriented" network

⁷¹ Such a policy is consistent with the position the Commission has taken in other proceedings such as Implementation of the Local Competition Provisions in the Telecommunications Act of 1996, CC Docket No. 96-98, FCC 96-325 (rel. August 8, 1996).

providing connection-like services using new technologies such as ReSerVation Protocol (RSVP). While X.25 has been around since the late 1970s, the RSVP offerings are only now coming to market. The best application and market role of each of these competing technologies can only be determined within the powerful constraints of open, innovative and unregulated markets.^{8/}

A. The Commission Can Encourage The Efficient Transport Of Internet Traffic On LEC Switching Facilities Through Reliance On Market Forces

The Notice asks how the Commission should create rules for effective incentives to deploy facilities needed for more efficient transport of Internet traffic via LEC switching facilities.^{9/} Reports submitted by LECs indicate that Internet packet-switched traffic is generating unprecedented congestion on LEC switches, posing the risk of service degradation or even disruption.^{10/} The Commission also asks for comments on possible

^{8/} See generally M. Steenstrup, Routing in Communications Networks (1995) (noting that demand driven by both the Internet and the voice grade telephony network are encouraging hybrid technologies such as fast packet-switching and photonic networks).

^{9/} Notice at ¶ 313.

^{10/} See, e.g. Notice at ¶ 286 n. 386 (citing letters from LECs regarding network congestion and Internet traffic). The extent of the traffic congestion problem is in dispute between the connected computing and transport industries. The Chairman's office has asked that the Network Reliability and Interoperability Council ("NRIC") look into the matter. *Id.* at ¶ 287.

hardware solutions such as new switches, asymmetrical digital subscriber lines ("ADSL") or wireless alternatives.^{11/}

When viewed in static terms from the vantage of today, the issue of network congestion appears only to grow in scope. Worldwide, computer users have purchased 150 million PCs since 1980. Internet traffic, already alleged to be impairing the underlying PSTN, will increase as the installed base of PCs reaches an estimated 200 million PCs by the end of the decade.^{12/} It is sobering to realize that the congestion issues mentioned in the Notice are based largely on traffic demands in the U.S. from only approximately 7% (or some 10 million PCs) which are currently connected to the Internet.^{13/} A significantly higher portion of the PC installed base can be expected to move on-line in the near future. New, non-PC based services such as set-top boxes attached to televisions, Network Computers and processor-enhanced telephones will also increase TCP/IP traffic and the use of the voice network in the short term.

^{11/} *Id.*

^{12/} The actual totals may be higher, with new TCP/IP platforms such as the so-called Network Computer and television set-top boxes come to market. The 200 million estimate is likely to be conservative even for PCs. Intel estimates that it shipped approximately 60 million x86 chips in 1995 and expects shipments to exceed 100 million by the year 2000. See Internet Report, *supra* note 5 at 1-5.

^{13/} *Id.*

Nortel's own engineering assessment shows that circuit-switched voice network congestion is a cause for concern. Nortel believes, however, that because digital technologies are inherently distinct from analog precedents and scale differently,^{14/} the Commission should refrain at this time from seeking a regulatory solution for congestion and related issues. LEC circuit-switches supporting large ISPs may experience unusual loads. Certainly, the absolute number of new Internet users and associated traffic loads will increase. Correspondingly, the options presented by digital microprocessors and software^{15/} to deal with the added demand load will also grow. These options

^{14/} See generally Tapscott, *supra* note 4 (noting the fundamental differences between digital and analog technologies); N. Negroponte, being digital (1995) (same).

^{15/} For example, some industry observers predicted that Internet growth would be halted by lack of unambiguous addresses for new hosts. The existing IP protocol assigns a unique 32 bit number for each host in the familiar pattern of four 8 bit numbers separated by dots (the dotted octet). The surge in new hosts led some to call for regulation to ration IP addresses. A software upgrade to new IPng (v6) will permit longer and hence more addresses. Combined with technological advances such as dynamic address allocation and Network Address Translators, IPv6 can alleviate concerns without recourse to centralized regulation of addresses. See generally Rekhter, Resnick and Bellovin, Financial Incentives for Route Aggregation and Efficient Address Utilization on the Internet, (August 29, 1996).

Similarly, improvements in other types of protocols may also significantly address congestion concerns. The Hypertext Transfer Protocol ("HTTP") utilized for the Web will be upgraded to improve efficient use of the network. IP Multicast, developed over a four year research effort on the Multicast Backbone ("MBONE"), if adopted, enables efficient bandwidth usage for applications that distribute data to multiple recipients.

for Internet access spurred by local competition make regulatory solutions based on static assumptions not only unnecessary but can be, in fact counterproductive. Policies fostering competition will stimulate industry to offer technologies and solutions that best meet consumers' needs.

1. Moore's Law

Consider the impact of Moore's Law.^{16/} Increasingly low cost processing power creates economic incentives for deployment of packet switched networks (such as the Internet)^{17/} and other "flatter" network architectures, both terrestrial and

^{16/} According to Moore's Law, named after Gordon Moore of Intel, since the advent of the microprocessor in 1971, each new generation doubles in processing power approximately every 18 months, while the manufacturing price falls by 50%.

^{17/} Growth in the Internet has corresponded with the availability of low cost microprocessing. For example, in 1969, when the Internet arguably was formed, there were only 4 computers online for ARPAnet. K. Hafner and M. Lyon, Where Wizards Stay Up Late: The Origins of the Internet 77 (1996). Mainframe computers dominated computing and the minicomputer industry had not fully formed. By 1983, still only 200 computers were online and users totalled less than 2,000. Tapscott, *supra* note 4, at p. 16.

Because of Moore's Law and the availability of low cost microprocessing, the Internet in early 1997 consists of 70,000 computer networks worldwide. It is doubling in total size annually or at a rate of .019% per day, measured by the new number of host computers coming online. In the first half of 1996, 3.5 million new computer hosts came on line. Fitzpatrick, Internet Congestion: Crisis or Come On?, Wescon '96 (Oct. 23, 1996). Packet traffic increased from 85 million packets in January 1988 to over 85 billion in 1994. MacKie-Mason and Varian, Economic FAQs About the Internet 2 (June 1996) (describing Internet growth).

wireless.^{18/} Applying the principles of Moore's Law to the congestion problem, Nortel notes that the cost of routing/switching will continue to decline relative to lines while the performance of the routers and other devices will increase. The economics of distributed computing indicates that the increased microprocessing power should be deployed at the periphery closer to the end-user -- and this is precisely where the circuit-switched voice network's efficiency is compromised.^{19/}

Theory is being borne out in practice. Companies are already bringing to market routers and other technologies to intercept data packet traffic before it reaches an LEC circuit-based switch. Nortel, for example, offers the Internet Thruway

^{18/} Traditional circuit-switched networks such as the PSTN were designed around relatively high-priced switching costs and correspondingly cheaper lines. These networks featured fewer switches, deployed in hierarchical fashion, and compensated with large numbers of lines. Once a call is set up, a line is dedicated to its use regardless of rate of data transmission. This was more economical for switched networks because no further routing calculations are required. With Moore's Law, the cost of switching becomes relatively and absolutely cheaper than lines. Packet switching is therefore more economical for certain services such as e-mail and lines shared by multiple switches. Moore's Law is making transport a commodity.

^{19/} The distributive impact of digital technologies on network architectures is a prominent part of the underlying analysis in P.W. Huber, M.K. Kellogg & J. Thorne, The Geodesic Network II: 1992 Report on Competition in the Telephone Industry (1992). See also Hausman and Tardiff, Efficient Local Exchange Competition: Recent Competition Issues in Telecommunications, Antitrust Bulletin (Sept. 22 1995) (noting that microprocessors have turned many formerly hierarchical local network switches into essentially personal computers (remote switches) deployed at the periphery of the network near customers).

for its customers, which is being successfully deployed by carriers. SBC Communications recently announced on January 14, 1997 the Internet/Intranet Transport Service ("IITS"). IITS deploys advanced routers which detect data calls and re-directs them at the originating switch. Data traffic is therefore by-passed from the voice-grade switch and off the voice-grade network.^{20/} Other carriers have announced the intention to introduce similar services.

The absence of barriers to entry in digital markets ensures that given the sufficient market demand for creative solutions to network congestion issues, other potential new entrants likely will offer competing solutions, further lowering prices, spurring innovation and providing choices. Compared to the dynamic nature of digital technologies, a regulatory approach, no matter how detailed or prescient, at best will likely soon be rendered obsolete. At worst, the rules themselves then become an obstacle to competition, innovation and the creation of customer value.^{21/}

^{20/} *Southwestern Bell Introduces New High Speed Route For Internet Call Traffic, Quick Signal* (January 14, 1997).

^{21/} As the Commission contemplates the future implications of Moore's Law, it should anticipate that embedding microprocessors into more consumer goods, households and appliances will continue. These embedded microprocessors also will likely require some form of access to a digital network in the not too distant future.

This outcome is not limited to landline solutions. Congestion and related problems may vary for particular customers, business cases or local conditions. Alternatives such as wireless technologies could offer the best value for customers. The Commission should refrain from adopting regulations which would hinder the ability of carriers and consumers to mix and match the best combination of technologies and price points suitable for customers and local market conditions.

The same caution applies to other issues such as widely noted bandwidth constraints on Internet development. Until recently, informed observers declared that a V.34 modem connecting at 33.6 kbps represented the best performance possible over twisted pair analog lines.^{22/} Advances in digital signal processing and software compression technologies, however, have substantially improved the utility of traditional analog twisted pair copper lines. Consumers now are offered modems featuring transmission rates over analog voice lines at 56 kbps -- the same speed as the original NSFNET backbone established in 1986. This is yet another example of how innovation driven by market demand and dynamic change should be allowed to respond to consumers' requirements without regulatory distortions.

^{22/} See, e.g., Internet Report, supra note 5, (noting that after 28.8/33.6 modems, ISDN would be required).

2. New services may change the network

Nortel believes that the quickly evolving nature of Internet content and applications using Java and other innovations such as first generation software agents also counsel against adoption of regulations at this time. Even more clearly understood applications such as Internet telephony, video conferencing and real-time streaming of audio and video are still in their infancy. While it is conceivable -- even likely -- that one or more of these applications may develop into broader consumer acceptance and usage, it is impossible to know how, when and with what impact on the network.

Complicating matters further are changes in traditional Internet usage. Historically, end-users followed the so-called "pull" model. A user located information or data desired somewhere on the Internet and downloaded the bits from the remote host or server. The user "pulled" the information off the network. This pattern accounted for approximately 80% of Internet usage in 1996.^{23/}

A new business model utilizes a server to "push" information from a host computer to an end-user. The technology may prove to be revolutionary for using and distributing

^{23/} Internet Report, *supra* note 5, at 5-1.

software applications over the Internet.^{24/} Many companies pioneering this technology are typically start-ups, some in existence for little more than a year. It is too early to tell if push technologies will find widespread consumer acceptance. Should they do so, new issues regarding network utilization and traffic patterns will likely arise.

In summary, it would be premature at this time for the Commission to consider adopting a regulatory approach to address local PSTN congestion. The Internet and its applications are still in their infancy. No one can predict the technological winners and losers from this vantage. Nor would it be in the best interests of the public to codify guesses in the rules.

B. The Commission Should Make Sure That Rules Provide A Return On Investment Commensurate With The Risk For Deployment Of New Facilities

The Notice asks what regulatory barriers at the Federal and State level might create disincentives for deployment of new facilities to address network congestion.^{25/} The Commission should not impose any artificial disincentives to the deployment of any new facilities that may prove necessary to congestion

^{24/} The venture capital firm of Kleiner, Perkins Caufield & Byers recently committed the first investments of its \$100 million Java fund to a new company, Marimba, developing this technology. The VC firm subsequently took a substantial equity position as well. See generally *Channeling Java*, The Red Herring 28-32 (Dec. 1996). Microsoft is also planning on embedding so-called broadcast technology into its next generation of server technology.

^{25/} Notice at ¶ 314.

problems. Attempts to limit depreciation rates or rates of return could cause such disincentives. This is of particular concern given the implications of dynamic change on the commercial lifecycles of digital equipment and infrastructure. Nortel believes that the Commission should revise rules to allow carriers to make a return on investment commensurate with the risks and investment being undertaken.

All rules which affect a carrier's or an ISP's revenues and costs have a direct impact on investment decisions by carriers, ISPs and their customers. Nortel believes that because the Internet is a turbulent, developing industry, some means must be allowed for carriers to obtain returns appropriate for the level of risk involved. While the rewards for success in the industry are well known, so too are the penalties for missteps. The Commission should review its rules so that they do not restrict the ability of carriers to align properly the ratio of potential returns with the associated risks. Such informed investment decisions will benefit carriers, the industry and consumers alike.

III. CONCLUSION

Nortel believes that the Commission should rely on market forces to resolve technical issues such as what solutions should be deployed to ensure satisfactory customer service. Nortel supports efforts to encourage incumbent LECs and all other carriers to invest in this emerging market. Nortel believes the potential for the American economy and consumer is significant and can be realized only if the Commission continues its pro-competitive, market-oriented approach.

Respectfully submitted,



Stephen L. Goodman
David E. Colton
Halprin, Temple, Goodman & Sugrue
1100 New York Ave., N.W.
Washington, D.C. 20005
(202) 371-9100

Counsel for Northern Telecom Inc.

Of Counsel:

John G. Lamb, Jr.
Northern Telecom Inc.
2100 Lakeside Boulevard
Richardson, Texas, 75081-1599

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